

CONSUMPTION-SAVING INVESTIGATION: UNITED STATES

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Abstract

This paper uses historical data from the United States to investigate the simple Keynesian consumption-income relationship. When structural breaks are taken into account, the theory of the simple Keynesian consumption function performs quite well in describing what is seen in the US data. Students and instructors of macroeconomic theory should be interested in these results, which demonstrate that the simple Keynesian consumption function does indeed perform quite well as a first approximation of the consumption-income relationship.

Key Words: consumption function, Keynesian, cointegration, structural change

JEL Classifications: E12, E21, A22

Introduction

When teaching the simple Keynesian model in undergraduate macroeconomics, most of us show our students the simple Keynesian consumption function and explain students that Keynes believed that the level of real consumption expenditure was a stable function of real disposable income. Further, we explain that while Keynes did not deny that other variables affect consumption, he believed that income was the dominant factor determining consumption. Thus, as a first approximation, we ignore other influences and investigate the Keynesian consumption-disposable income relationship: $C = a + b Y_D$, with $a > 0$ and $0 < b < 1$. In this Keynesian consumption function, the intercept term (along with the error term) can be thought of as the effect on consumption of variables other than disposable income (variables not explicitly included in the model). Thus, the intercept term is expected to be positive. The Keynesian assumption on the slope coefficient is that an increase in disposable income will lead to an increase in consumption, but this increase in consumption will be less than the increase in disposable income. Hence, the slope (marginal propensity to consume) is expected to be positive but less than one. Once we have the simple Keynesian consumption function the simple saving function is implicitly determined: $S = -a + (1 - b) Y_D$.

This paper investigates the simple Keynesian consumption function and the implicitly determined saving-income relationship. Does this consumption function describe what we see using historical data or is this model too simple to explain what we see in the real world data? One potential problem of such a simple model is the possibility of omitted variable bias. As Keynes himself agreed, variables other than income certainly affect consumption. But, since we all teach this simple Keynesian consumption function and use it to find the marginal propensity to consume, the marginal propensity to save, equilibrium in the simple Keynesian model, etc., then this simple consumption function should at least be a reasonable first approximation of the relationship between consumption and disposable income. Otherwise, why should we expect our students to agree with any of the textbook policy implications of the Keynesian model?

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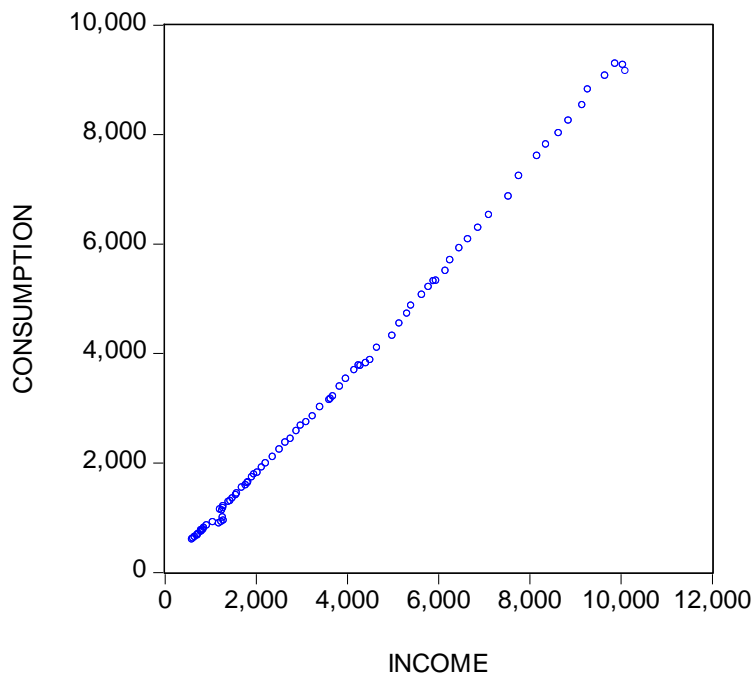
Therefore, the purpose of this article is to investigate whether the simple Keynesian consumption function gives anywhere close to reasonable results when using real world data for the United States. Using historical US data for personal consumption expenditures and disposable income, a simple Keynesian consumption function is estimated and the reasonableness of the results is evaluated.

Data

The data used in this paper are obtained from the National Income and Product Accounts Tables, US Department of Commerce: Bureau of Economic Analysis. Consumption is real personal consumption expenditures (billions of chained 2005 dollars). Income is real disposable personal income (billions of chained 2005 dollars). This study considers annual data for both of these series starting in 1929 and ending in 2009.

Figure 1: Consumption and Income 1929 – 2009

(Note that both axes are measured in billions of chained 2005 dollars)



Estimation Results

To begin, a graphical representation of the relationship between consumption and disposable income from 1929 to 2009 is presented in Figure 1. This graph suggests that there is a linear relationship between consumption and disposable income. The relationship between consumption and disposable income is estimated using OLS.

$$(1) \text{ Consumption} = -83.70 + 0.93 \text{ Income}$$

p-values: (0.0001) (<0.0001)

Adj. $R^2 = 0.9984$

At first glance, the simple Keynesian consumption function does not appear to perform well at all, using the US data. The intercept, which Keynes assumed to be positive, is negative and highly significant, while the marginal propensity to consume is positive but less than one, as expected.

Omitted variables may be causing this unreasonable result for the intercept term, but there is another possible explanation that should be investigated before scrapping the simple Keynesian consumption function. Since this analysis uses time series data to estimate the relationship between consumption and income, it is imperative that the relationship remain stable over time in order for the results to be useful. Therefore, before continuing we should test for structural change(s) in the consumption-income relationship. In other words, we will test whether the marginal propensity to consume (slope coefficient) and the intercept remain stable over time or if the slope and/or intercept are different during different time periods.

Andrews (1993) and Andrews and Ploberger (1994) proposed tests for one or more unknown structural breakpoints in the parameters of the equation. The basic idea behind these tests is to compute a test statistic, say, $W(\tau)$, for each possible breakpoint τ (where there are k possible breakpoints), then calculate a function of these tests statistics to use as the test for structural change. The test statistics proposed by Andrews (1993) and Andrews and Ploberger (1994) are $\text{Max } W(\tau)$, $\text{Mean } W(\tau)$, and $\text{Exp } W(\tau)$, where

$$\begin{aligned}\text{Max } W(\tau) &= \max_{\tau_1 \leq \tau \leq \tau_2} W(\tau), \\ \text{Mean } W(\tau) &= \frac{1}{k} \sum_{\tau=\tau_1}^{\tau_2} W(\tau), \text{ and} \\ \text{Exp } W(\tau) &= \ln \left(\frac{1}{k} \sum_{\tau=\tau_1}^{\tau_2} \exp \left(\frac{1}{2} W(\tau) \right) \right).\end{aligned}$$

The distribution of these test statistics is nonstandard. Hansen (1997) provided approximate asymptotic p-values for these tests. However, the distribution of these statistics becomes degenerate as τ_1 approaches the beginning of the sample or τ_2 approaches the end of the sample. To compensate for this behavior, the general practice is to exclude some observations from the beginning and end of the sample. This “trimming” is commonly 15% (exclude the first and last 15% of the observations).

We begin by dropping the data corresponding to US involvement in World War II from the analysis. These wartime observations for 1942 – 1945 are excluded, because this sub-sample period contains only four observations, which leaves only two degrees of freedom once the coefficients are estimated.² This gives two sample periods to initially consider: 1929 – 1941 and 1946 – 2009. We do not test for structural breaks in the sub-sample period 1929 – 1941 since this sub-sample consists of the years of the Great Depression leading up to the beginning of US involvement in World War II.

$$\begin{aligned}(2) \text{ Sub-sample period 1929 – 1941:} \\ \text{Consumption} &= 160.72 + 0.73 \text{ Income} \\ \text{p-values:} & (<0.0001) (<0.0001) \\ \text{Adj. } R^2 &= 0.9785\end{aligned}$$

² The analysis and tests for structural change were also carried out on the entire data set and the results were nearly identical.

- (3) Sub-sample period 1946 – 2009:
 $\text{Consumption} = -121.97 + 0.93 \text{ Income}$
 p-values: (0.0174) (<0.0001)
 $\text{Adj. } R^2 = 0.9983$

Table 1: Tests for unknown structural breaks in equation (3)

	Test Statistic	p-value
Max W (1986)	65.55	<0.0001
Exp W	30.06	0.0001
Mean W	40.40	0.1664

Notes: The max and exp statistics reject the null hypothesis of no structural change in either the slope or the intercept, but the mean statistic fails to reject the null hypothesis. The maximum statistic occurred in 1986, and that is the most likely breakpoint location. Test sample is 1956 – 1999.

We now use the tests for unknown structural breakpoints described above to investigate the stability, or lack thereof, of the simple Keynesian consumption function. We begin by testing equation (3) for structural breaks in either the slope coefficient or the intercept (note that this is a joint test, which is testing the joint hypothesis that both the slope and the intercept are stable). With 15% trimming this gives a test sample from 1956 to 1999. The test statistics and the corresponding p-values are reported in Table 1. For equation (3), the Max and Exp statistics reject (at the 5% significance level) the null hypothesis of no structural change but the Mean statistic does not reject the null hypothesis (at the 5% significance level). The most likely breakpoint is identified by the maximum statistic which occurred in 1986. Thus, we proceed by estimating separate equations for the two sample periods identified: 1946 – 1985 and 1986 – 2009.

- (4) Sub-sample period 1946 – 1985:
 $\text{Consumption} = 80.92 + 0.86 \text{ Income}$
 p-values: (<0.0001) (<0.0001)
 $\text{Adj. } R^2 = 0.9993$
- (5) Sub-sample period 1986 – 2009:
 $\text{Consumption} = -434.49 + 0.98 \text{ Income}$
 p-values: (0.0001) (<0.0001)
 $\text{Adj. } R^2 = 0.9968$

We now repeat the process of testing for structural changes in these two sub-sample periods (equations (4) and (5)). The test statistics and the corresponding p-values are reported in Table 2. For the sub-sample period 1946 – 1985, each of the test statistics fails to reject the null hypothesis of no structural change. For equation (5), the Max and Exp statistics reject (at the 5% significance level) the null hypothesis of no structural change but the Mean statistic does not reject the null hypothesis (at the 5% significance level). The most likely breakpoint occurred in 2005.

Table 2: Tests for unknown structural breaks in equations (4) and (5)

	Test Statistic	p-value
Sample period 1946 – 1985		
Max W (1946)	1.67	0.9996
Exp W	0.19	1.0
Mean W	0.34	1.0
Sample period 1986 – 2009		
Max W (2005)	16.69	0.0021
Exp W	6.58	0.0020
Mean W	3.20	0.15

Notes: None of the test statistics reject the null hypothesis of no structural change in either the slope or the intercept for the sample period 1946 – 1985. Test sample is 1952 – 1979. For the sample period 1986 – 2009, the max and exp statistics reject the null hypothesis of no structural change but the mean statistic fails to reject the null hypothesis. The maximum statistic occurred in 2005. Test sample is 1990 – 2005.

Since two of the test statistics suggest the possibility of a structural break, we will also investigate the sub-sample period 1986 – 2004. The sub-sample period 2005 – 2009 is dropped from further analysis, as it does not contain enough observations for meaningful inference (after estimating the intercept and slope coefficient, only three degrees of freedom remain).

(6) Sub-sample period 1986 – 2004:

Consumption = $-545.60 + 0.99$ Income

p-values: (0.0000) (0.0000)

Adj. $R^2 = 0.9989$

Table 3: Tests for unknown structural breaks in equation (6)

	Test Statistic	p-value
Sample period 1986 – 2004		
Max W	4.54	0.6346
Exp W	0.69	0.7199
Mean W	0.80	0.8473

Notes: For the sample period 1986 – 2004, the test sample is 1989 – 2001.

For this sub-sample period 1986 – 2004, each of the test statistics fails to reject the null hypothesis of no structural change. The tests for structural change (and the corresponding p-values) for this sub-sample periods are presented in Table 3.

Discussion

In summary, three sub-sample periods have been identified in the investigation of the Keynesian simple consumption-income relationship. The estimation results for each of these sub-sample periods are compiled in Table 4.

Table 4: Sub-Sample Estimation Results

	Intercept	Marginal Propensity to Consume	Adjusted R²
1929 – 1941	160.72 (0.0000)	0.73 (0.0000)	0.9785
1946 – 1985	80.92 (0.0000)	0.86 (0.0000)	0.9993
1986 – 2004	–545.60 (0.0000)	0.99 (0.0000)	0.9989

Notes: One-sided p-values are reported. Marginal propensity to consume (MPC) is the coefficient on disposable income.

The first sub-sample period considered is 1929 – 1941, consisting of The Great Depression leading up to the beginning of US involvement in World War II. The Marginal Propensity to Consume (MPC) is estimated as 0.73 (corresponding Marginal Propensity to Save (MPS) of 0.27) and the intercept is positive. Both of these estimated coefficients are statistically significant and fall within the ranges expected by Keynes. The results for this sub-sample period provide support for the simple Keynesian consumption function.

We continue by considering the sub-sample period 1946 – 1985. The structural break can be thought of as the culmination of many events in the late 1970s and early 1980s. The US economy was coming out of a period of stagflation in the 1970s. In addition, many important events and changes in tax legislation occurred during President Reagan's two terms in office. Some of these events include the Tax Reform Act of 1986, the Gramm-Rudman-Hollings Balanced Budget Act, the Iran-Contra Scandal, the Space Shuttle Challenger accident, and the recession of the early 1980s. The estimated MPC during this period is 0.86 (corresponding MPS of 0.14) and the intercept is positive. Further, both of these coefficients are statistically significant and fall within the ranges expected by Keynes. Thus, the results for this sub-sample period also provide support for the simple Keynesian consumption function.

The final sub-sample period is 1986 – 2004. The structural break identified in 2005 can be thought of as the culmination of many events in the early 2000s. Some of these important events include the recession of the early 2000s, hurricane Katrina, and the subprime financial crisis and the subsequent recession. The estimated MPC is 0.99 (corresponding MPS of 0.01) and the intercept is negative. Both of these coefficients are statistically significant. The value of 0.99 for the marginal propensity to consume is within the range expected by Keynes, but is very high. This MPC suggests that during this period, 99% of additional disposable income was consumed. While this is much higher than the MPC for previous sample periods, the high value of the MPC for the late 1980s, 1990s, and beginning of the new millennium coincides with the often heard complaint of the period that Americans, in general, consume too much of their income and do not save. The negative value for the intercept is unexpected and difficult to explain in terms of the simple Keynesian consumption-income relationship. Perhaps this can also be attributed, at least in part, to Americans' consumption of almost all additions to disposable income during this period.

It will be interesting to come back to this question several years from now once more data are available to investigate the period 2005 and beyond. Ideally, the methodology used here can

be used to investigate the potential structural change(s) in the consumption-income relationship corresponding to the “great recession”.

In summary, the marginal propensity to consume in the United States has consistently increased from The Great Depression through the end of the century. During in the late 1980s and 1990s, the US marginal propensity to consume was as high as 99%.

Conclusions

The results provide at least some support for the simple Keynesian consumption function. When structural changes in the parameters are taken into account, the resulting estimates of the consumption function fit reasonably well with Keynes’s assumptions of a positive intercept and a positive marginal propensity to consume that is less than one. Using historical data from the United States, the simple Keynesian consumption function does indeed seem to be a reasonable first approximation ignoring other factors that could affect consumption.

For sub-sample periods considered through 1985, the simple Keynesian consumption function appears to perform quite well. For the most recent sample period beginning in 1986, the value of 0.99 for the marginal propensity to consume is within the range expected by Keynes, but is very high. While this is much higher than the MPC for previous sample periods, the high value of the MPC for the late 1980s, 1990s, and beginning of the new millennium coincides with the often heard complaint of the period that Americans, in general, consume too much of their income and do not save.

The negative value for the intercept post-1986, however, is unexpected and difficult to explain in terms of the simple Keynesian consumption-income relationship. Perhaps this can also be attributed, at least in part, to the fact that Americans consumed almost all additions to disposable income during this period. Another possibility is that the negative intercept is due to the U.S. economy becoming much more complex in recent decades such that the simple Keynesian consumption function cannot be used to describe the relationship between consumption and income any longer. Of course, it is certainly possible that the simple Keynesian consumption function will perform well again in future decades. It will be interesting to return to this investigation in the decades to come.

In conclusion, this study suggests that the simple Keynesian consumption function presented in most intermediate and principles macroeconomic courses and textbooks, is not only relevant for the development of the simple Keynesian models, but is also relevant in explaining the consumption-income relationship observed in the United States since The Great Depression. This should be of interest to both students and instructors of macroeconomics.

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